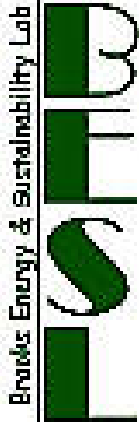


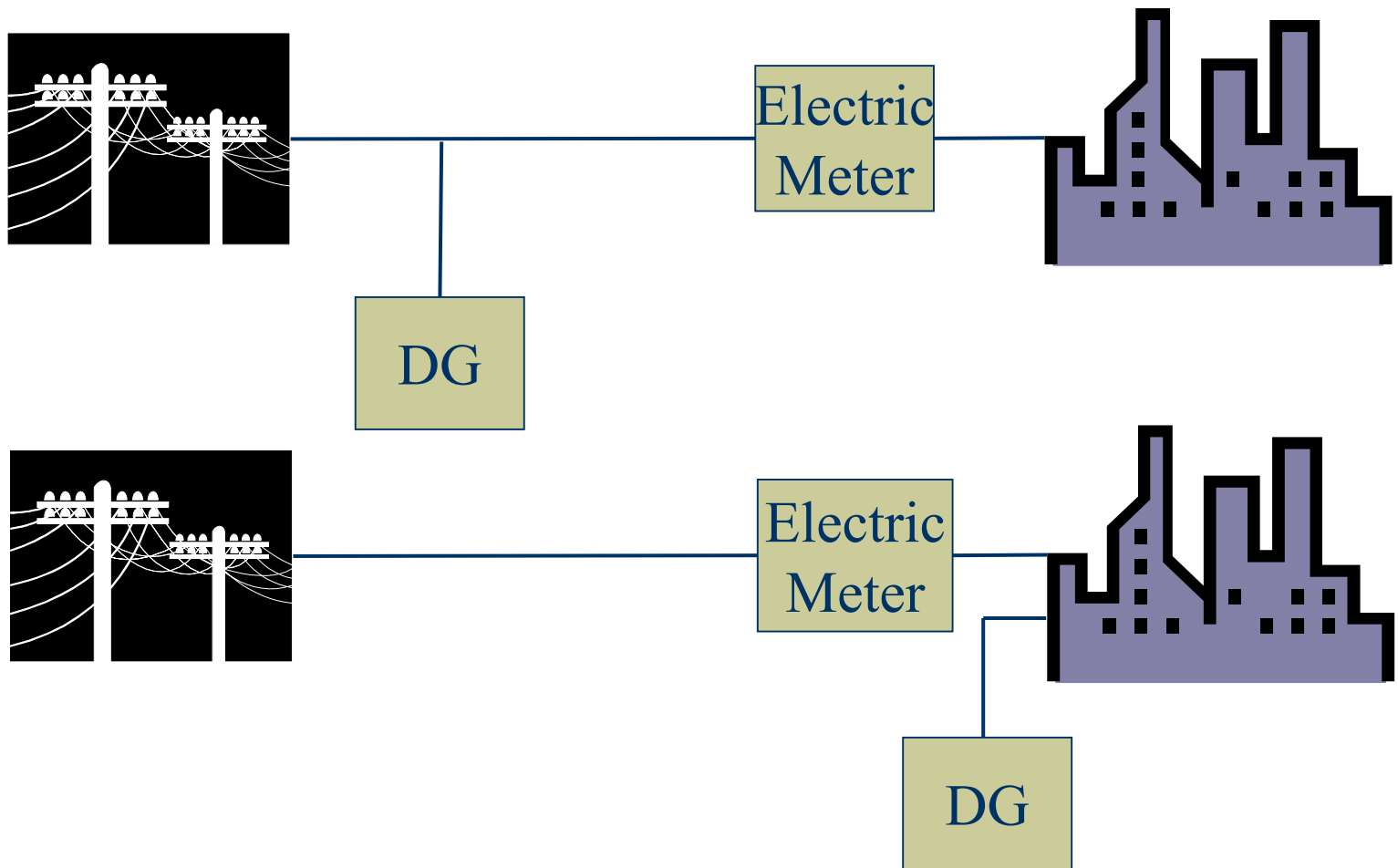
# Combined Heat & Power (CHP): Applications & Benefits



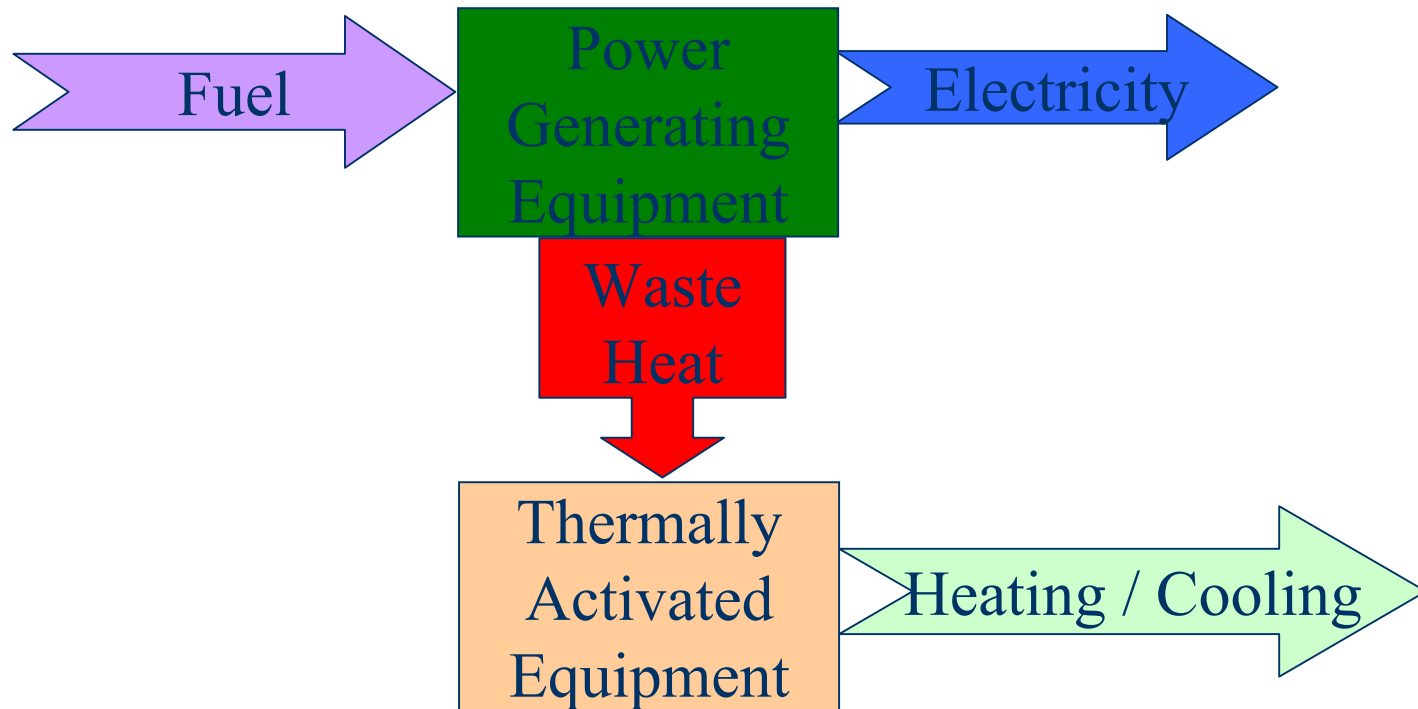
Valerie Harris, CPS  
Balaji Santhanakrishnan, BESL

June 2, 2003

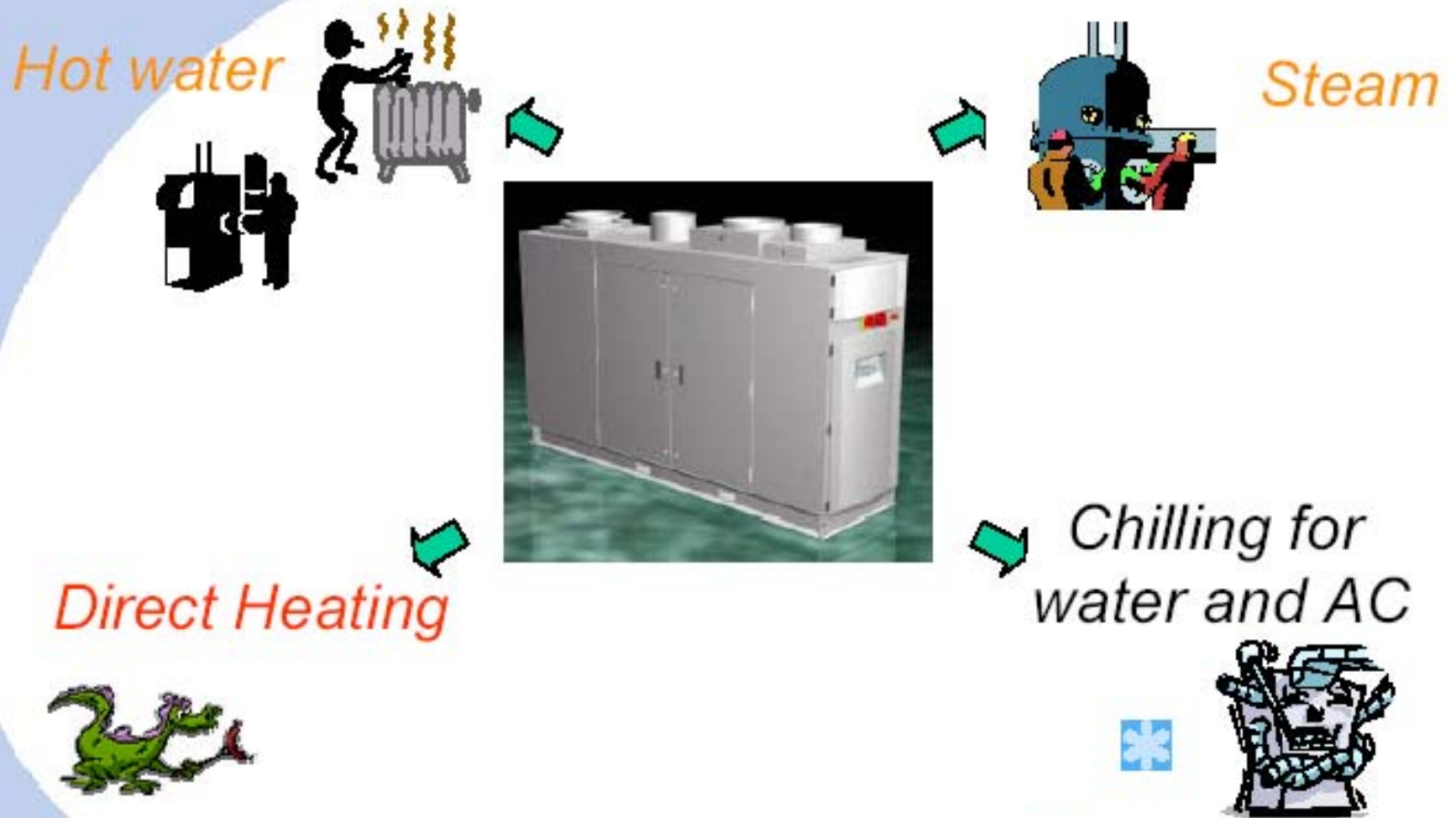
# Distributed Generation (DG)



# CHP Components



# CHP Applications



# CHP Technologies

- ◆ Reciprocating engines
- ◆ Microturbines
- ◆ Fuel Cells



Source: DOE

# Office of Distributed Energy Resources



Cooling Tower, Chiller, Microturbine



IC Engines



Solid Desiccant



Liquid Desiccant



University of Maryland  
Integration Test Center



# Office of Distributed Energy Resources



University of Maryland  
Integration Test Center





# Benefits



- ◆ Increased energy efficiency
- ◆ Onsite Power (grid for backup)
- ◆ Reduced electricity peaks
- ◆ Better power quality





# CHP Installation Checklist



- ◆ Permits required
- ◆ Materials needed
- ◆ Fuel Hookups
- ◆ Signage
- ◆ Fire safety requirements

# Permits

## ◆ State Air Permit

- Jim Linville 512-239-1261
- \$100-\$950 permit fee, small generators, Form PI-1S

## ◆ SAWS water management approvals

- Ms. Peggy McCray 704-7444
- codes compliance for water discharges, stormwater drainage, edwards aquifer zone
- no fees for small generators

# Permits (continued)

- ◆ City of San Antonio
  - Michael Clack 207-8236
  - covers bldg, plumbing, electrical, fire prevention, & stormwater discharge plans
  - Plan Review Fee \$250 Permit Fee \$650
- ◆ City Public Service Interconnect Riders E-5, E-8 or E-9
  - Ms. Karma Nilsson 353-2815
  - Application required, No fees

# Sample Installation Components - Fuel Cell

Lighting (optional)

Wiring/Junction Boxes/Meters/Disconnect Switch

Water pipe, valves, filters

Communication equipment & boxes

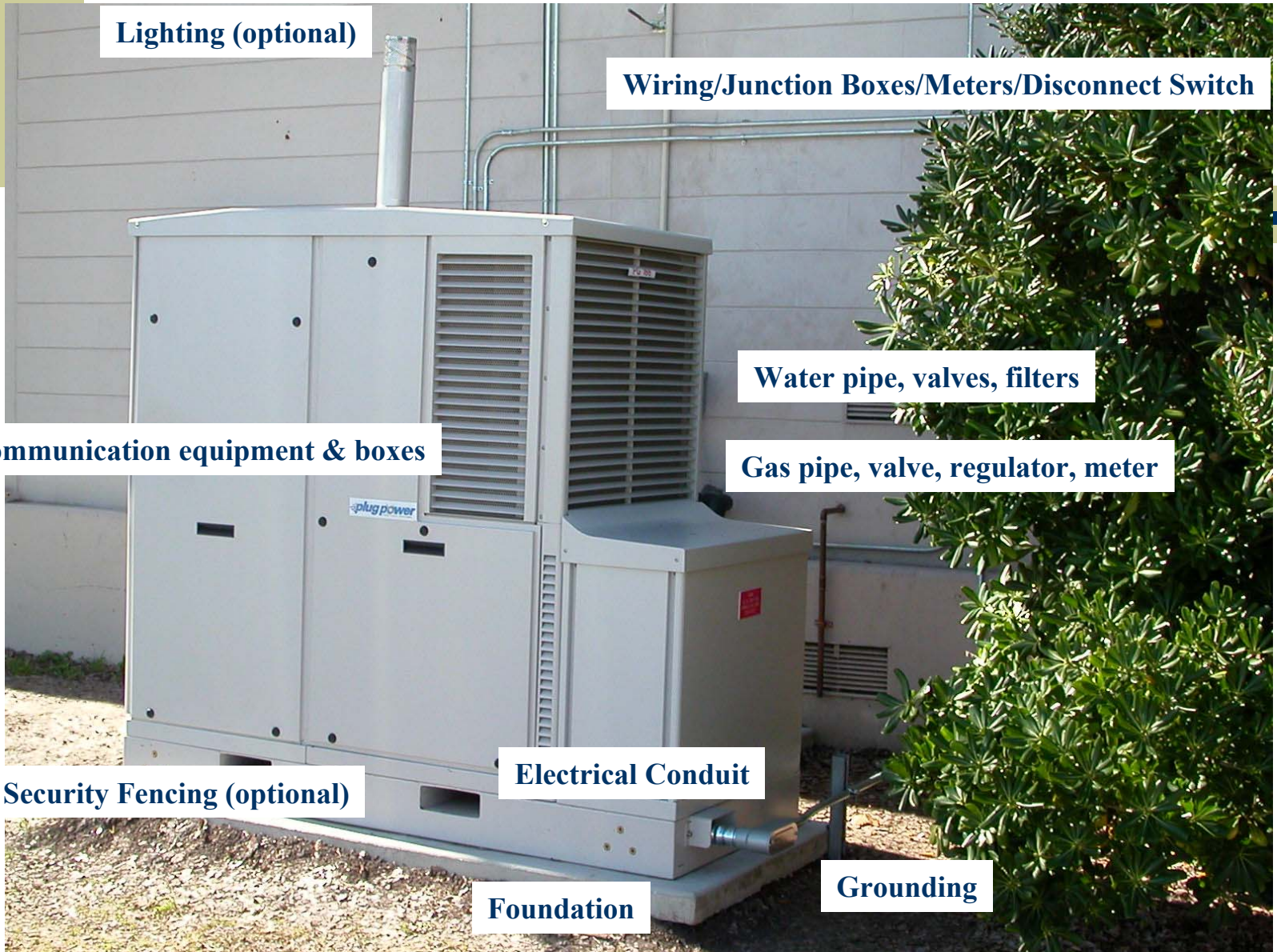
Gas pipe, valve, regulator, meter

Security Fencing (optional)

Electrical Conduit

Foundation

Grounding





## Challenger Learning Center Fuel Cell: waste heat recovery

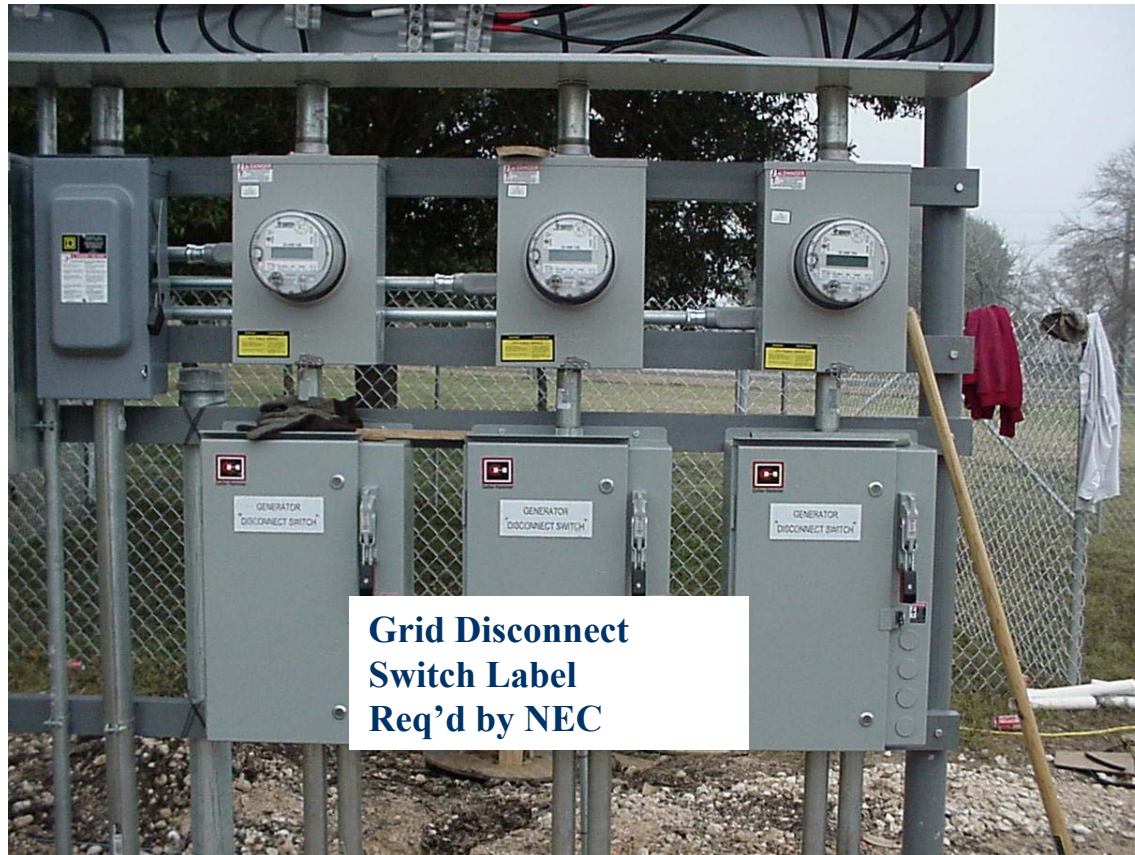


# Fuel Supply

## ◆ Natural Gas

- Contact CPS's Jack Reinhard 353-2635 for new gas service
- supply pressure-- 4 oz - 3 lb (O.K. for fuel cell)
- Booster pumps req'd for microturbines/IC engines (vendor quotes may or may not include item, BEST to ask)
- Customer pays for piping & metering from gas main to site/quotes are site specific

# Signage



**Grid Disconnect  
Switch Label  
Req'd by NEC**

# Signage (cont'd)

- ◆ Uniform Fire Code
  - must label
  - Hazardous materials
    - therminol
    - propylene glycol
    - oil
  - Flammable liquids
  - Combustible materials
    - hydrogen
    - natural gas
    - Propane





# Fire Safety

## ◆ City Fire Code:

- inventory of hazardous materials
- occupancy permit
- fire extinguisher req'd onsite- Note: cannot use water on electrical equipment
- Location must be easily accessed by Fire Truck
- Fire protection plan- can water be sprayed or not? Spill/pollution concerns, vessel rupture risks



# Phased Approach on CHP Projects



- ◆ Phase 1 - Initial Screening
- ◆ Phase 2 - Preliminary Analysis
- ◆ Phase 3 - Investment grade Analysis
- ◆ Phase 4 - Implementation

# Critical Check List

- ◆ Efficiency improvement opportunities in the existing facility
- ◆ Exhaust gas emission / Noise level requirements
- ◆ Load Match (thermal Vs electrical)

# Sensitive Parameters

- ◆ Electricity Cost
- ◆ Fuel Cost
- ◆ Load
- ◆ Power Generator Heat Rate
- ◆ O&M Cost
- ◆ Capital Cost
- ◆ Interest Rate

# Existing Plant Conditions

- ◆ Age of the Equipment
- ◆ Capacity of the Equipment
- ◆ Existing Cooling / Heating requirement
  - how much of capacity is redundant?



# First Cost vs. Life-Cycle Cost

- ◆ Energy Efficient Plant
  - Low Pressure Drop (chiller, valves, piping, coils)
  - High Efficiency Equipment (curves, selection)
  - Staging (Base load, Fluctuating load)
  - Control Optimization (e.g., CT, free-cooling, EMCS link, condenser temperature)
- ◆ Include in Economic Model

# Other Life-Cycle Issues

- ◆ Reliability/Stand-by Requirements
- ◆ Whole System Commissioning
- ◆ Measurement & Verification (M&V)
- ◆ Instrumentation (accuracy, test plugs)
- ◆ Operation & Maintenance

# System Integration Issues

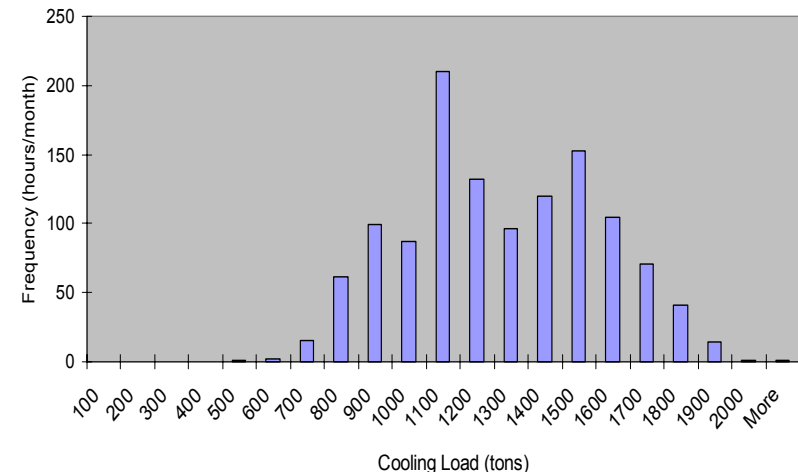
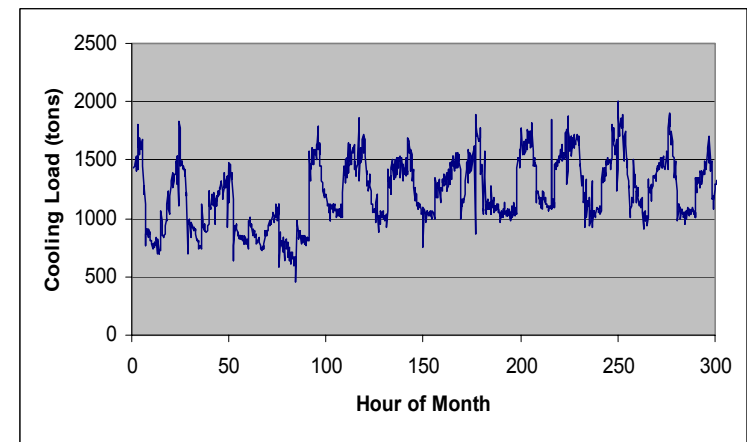
- ◆ How to Integrate with Existing System:
  - Electric Chillers / Cooling Towers, Boilers: Standby, Peak
  - New equipments: Pumps, VFD, Cooling towers etc.
  - Space requirements: Piping, Ducting, Electrical
  - Structural requirements
  - EMCS: CHP controls & HVAC controls



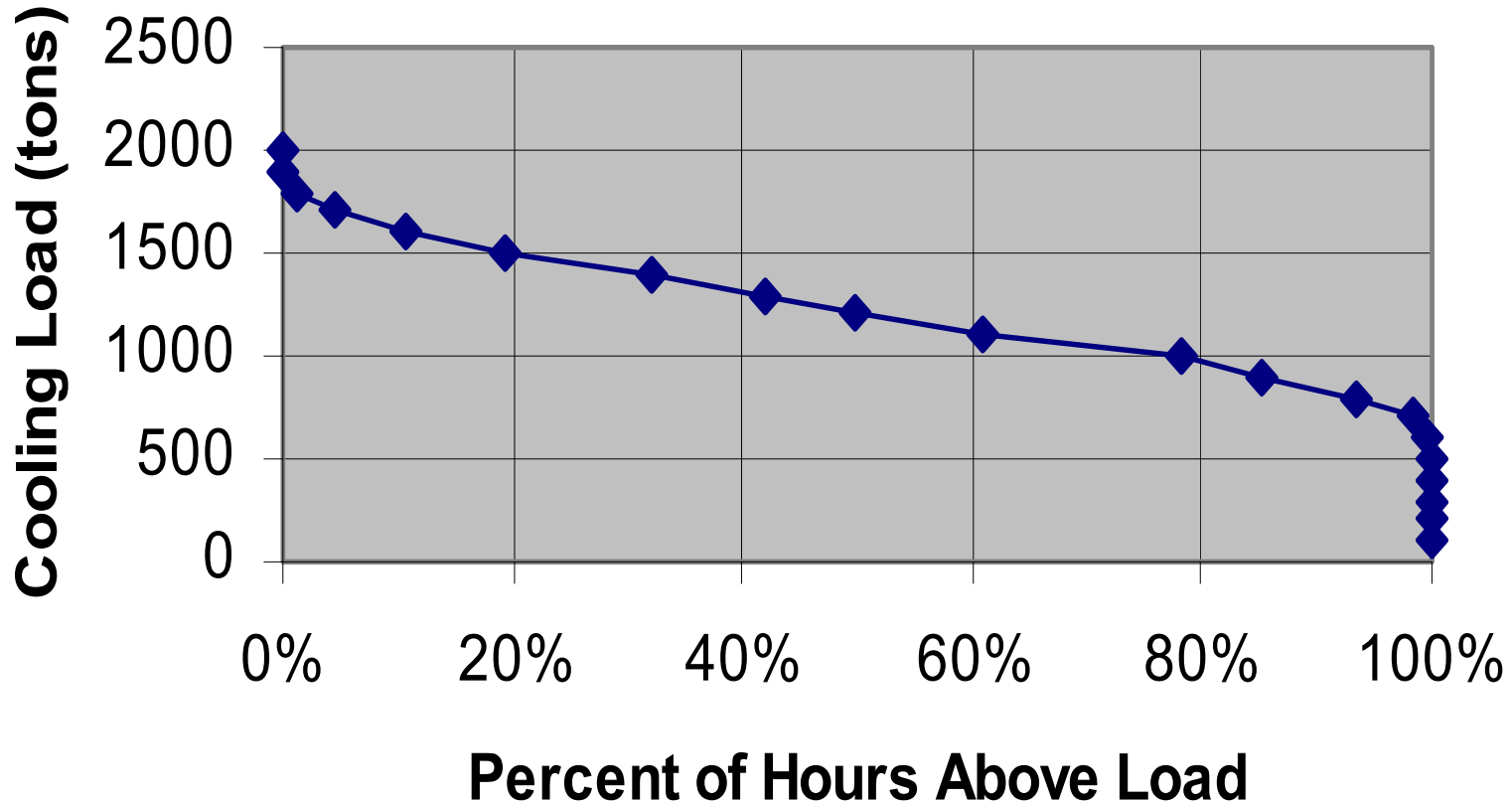


# Sizing is Key to Economics

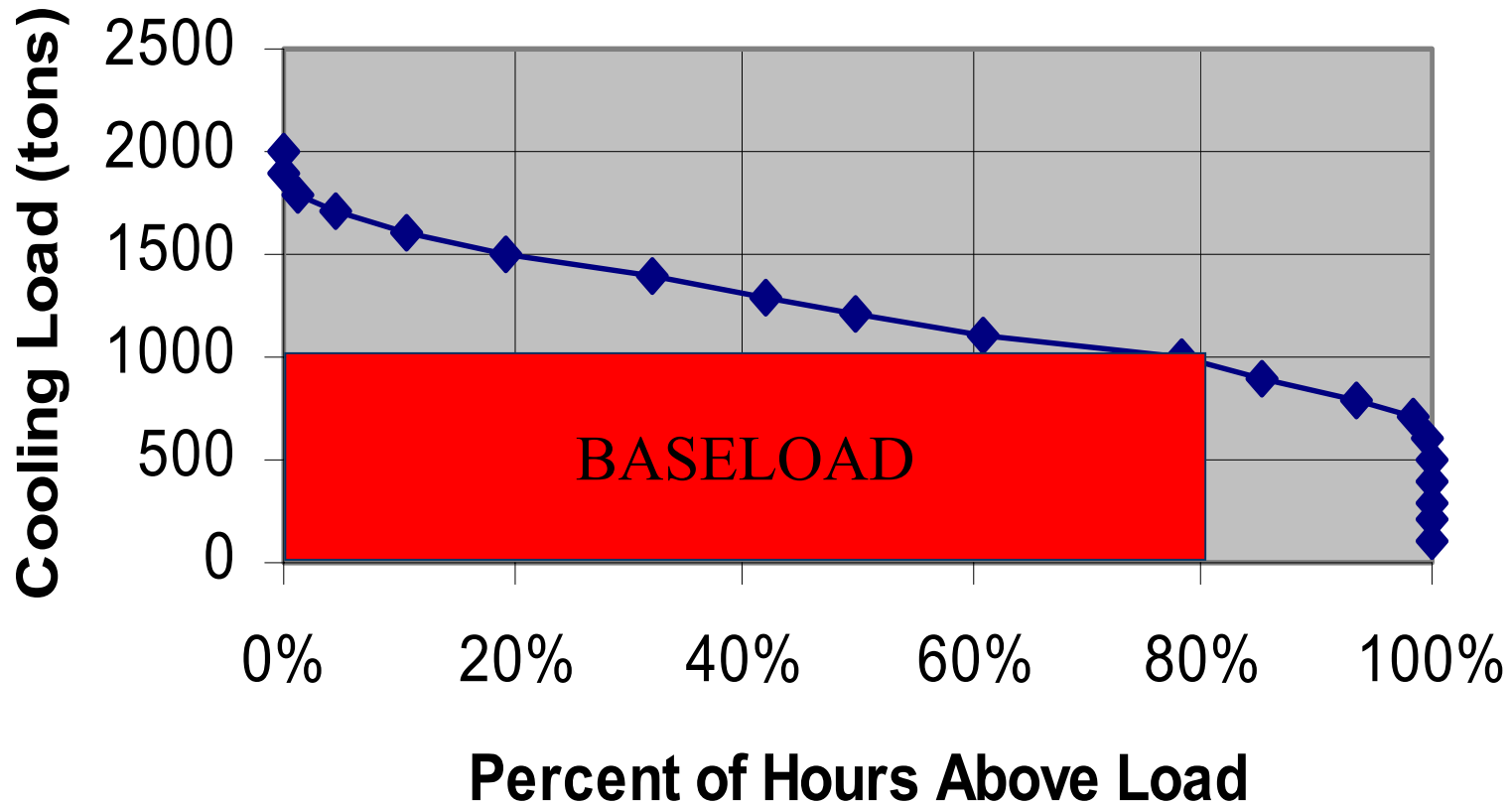
- ◆ Bldg Energy Profile is Fundamental (not avail for new bldgs)
- ◆ Matching Generator Size to Thermal Loads
  - Cooling or Heating?
- ◆ Customized Design to Match System Need
  - Hybrid design



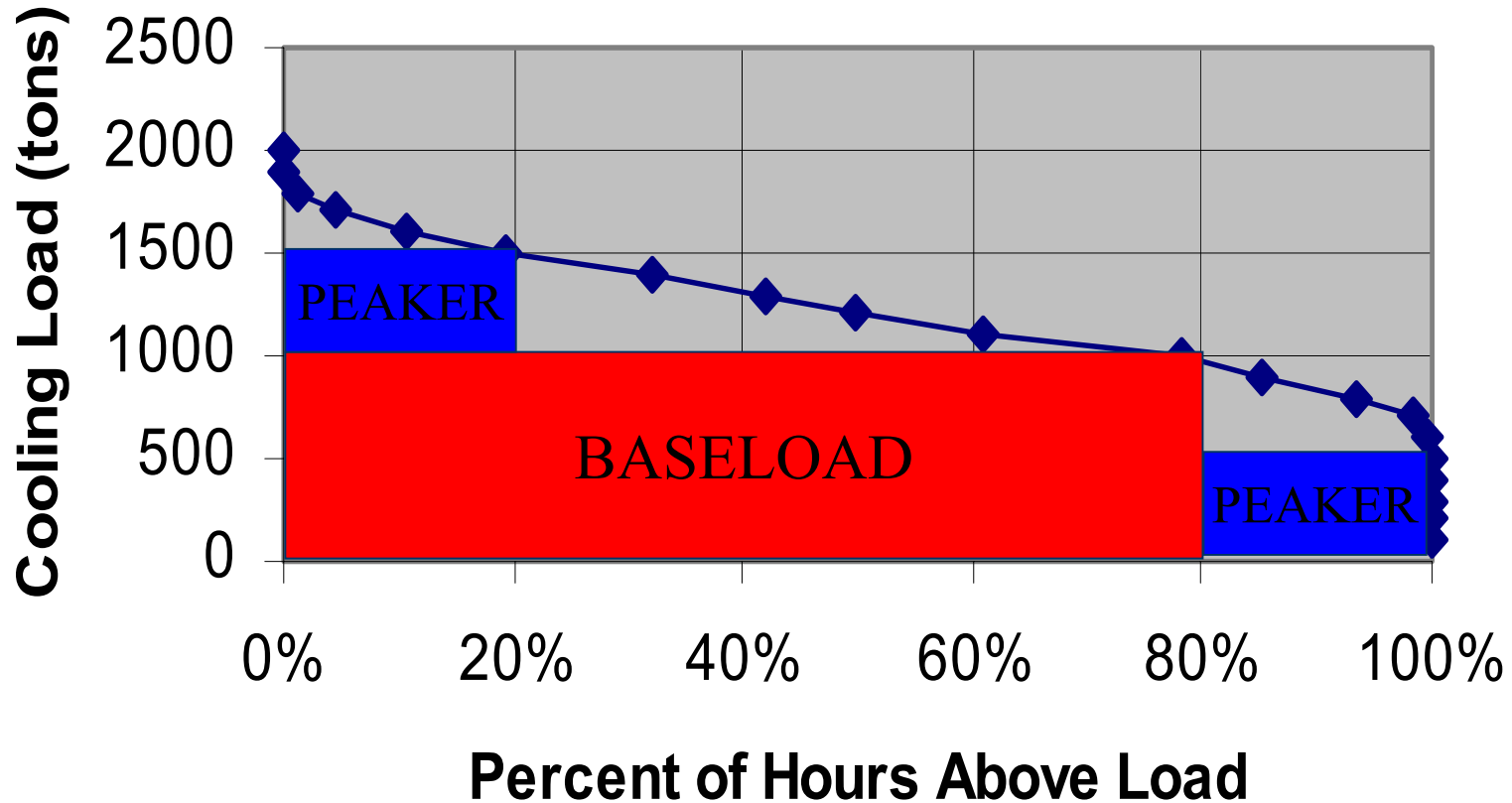
# Load Data for System Sizing



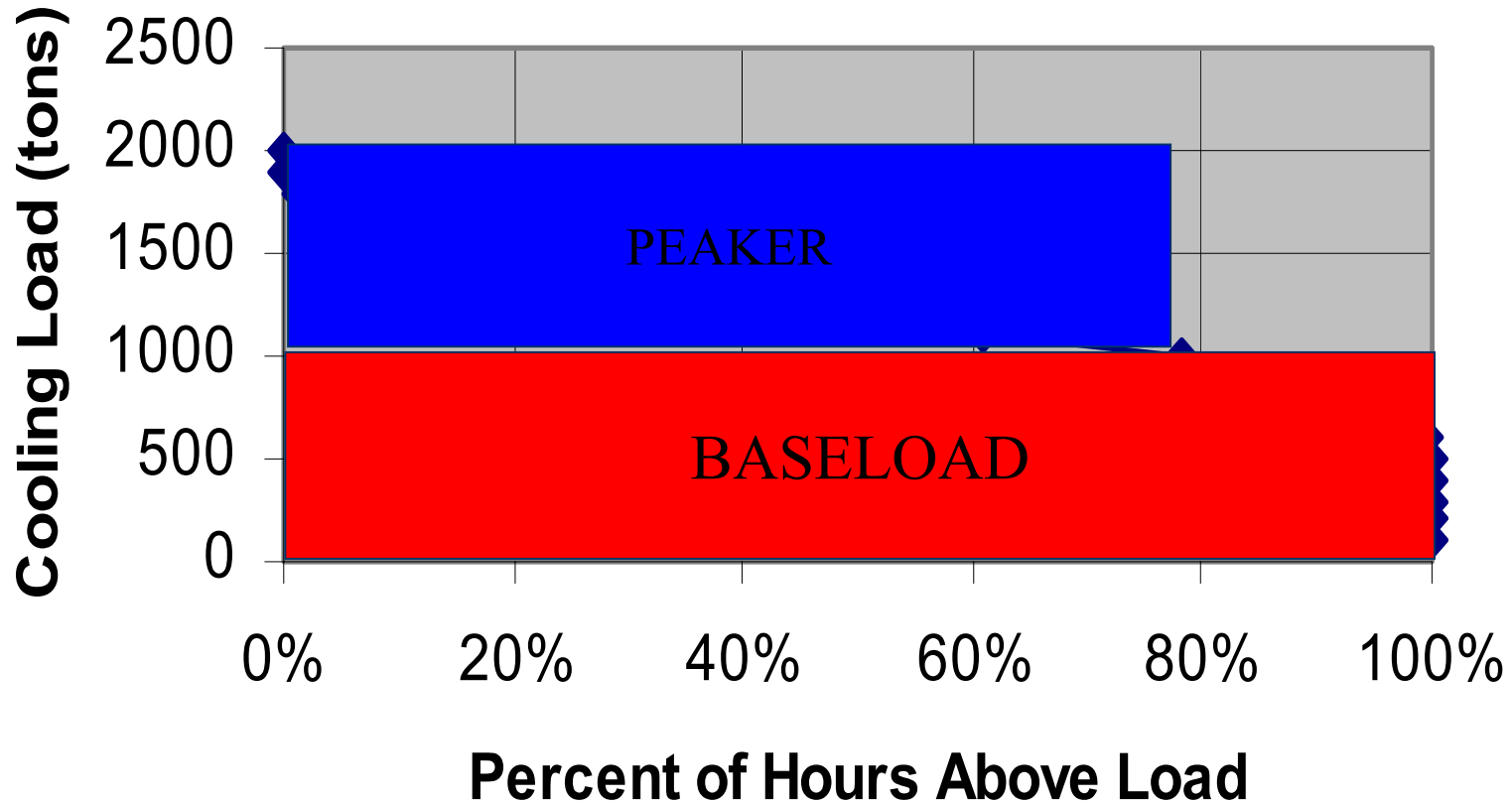
# Load Data for System Sizing



# Load Data for System Sizing



# Load Data for System Sizing



# CHP Summary

- ◆ Complex systems with congested (electrical, gas, water) service installation
- ◆ Various local government and private stakeholders working together to streamline evaluation and permitting processes
- ◆ Third party consultants/experts available locally to assist with installations